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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/675,627 | 09/29/2000 | Michael Rumer | M-8570 US | 9578 |

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| EXAMINER |
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PERKINS, PAMELA E

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| ART UNIT | PAPER NUMBER |
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2822

DATE MAILED: 02/20/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/675,627

Applicant(s)

RUMER ET AL.

Examiner

Pamela E Perkins

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 October 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10 and 18-30 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☒ Claim(s) 11-17 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

This office action is in response the filing of the amendment on 13 October 2003.

Claims 1-30 are pending.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4, 9, 10, 18, 20, 21 and 23-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevens (5,741,721) in view of Kitch et al. (6,277,726) and Yamadai (6,083,830).

Stevens discloses a method of forming a titanium layer on a substrate where a substrate is placed in a deposition chamber comprising a source of titanium, depositing the titanium layer onto the substrate in an atmosphere that comprises hydrogen (col. 14, lines 18-31). Stevens does not disclose forming the titanium layer by physical vapor deposition (PVD) and having a <002> orientation.

Kitch et al. disclose a method of forming a titanium layer on a substrate where a substrate (12) is placed in a deposition chamber comprising a source of titanium, depositing the titanium layer (13) onto the substrate by physical vapor deposition (PVD) in an atmosphere that comprises argon, then forming an aluminum layer (16) on the

titanium layer (13). Kitch et al. further disclose forming a titanium nitride layer (15) over the titanium layer (13) (col. 5, lines 6-30).

Since Stevens and Kitch et al. are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Kitch et al. would have been recognized in the pertinent art of Stevens. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Stevens by forming the titanium layer by physical vapor deposition (PVD) as taught by Kitch et al. to reducing the resistance of electrical coupling between conductive layers (col. 1, lines 8-11).

Yamadai discloses a method of forming a layer on a substrate where a titanium layer (3), with a <002> orientation, is sputter deposited on a substrate (1), then a titanium nitride layer (4), with a preferred <111> orientation, is formed on the titanium layer (3) and an aluminum layer (5), with a <111> orientation, is formed on the titanium nitride layer (4) (col. 3, line 17 thru col. 5, line 41; col. 5, lines 1-33).

Since Stevens and Yamadai are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Yamadai would have been recognized in the pertinent art of Stevens. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Stevens by the titanium layer having a <002> orientation, the titanium nitride layer having a <111> orientation and the aluminum layer having a <111> orientation as taught by Yamadai. A titanium layer with a <002> orientation prevents the formation of side-hole, openings in the sidewalls (col. 2, lines 21-55).

Referring to claim 29, Stevens does not disclose absorbing the hydrogen to a depth of about 50 Angstroms into the titanium target. It would have been obvious to one having ordinary skill in the art at the time invention was made to absorb the hydrogen to a depth of about 50 Angstroms into the titanium target. disclosed in the claimed invention, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955).

Claims 5 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevens in view of Kitch et al. and Yamadai as applied to claims 1-4, 9, 10,18, 20 and 21 above, and further in view of Freeman et al. (5,466,522).

Stevens discloses a method of forming a titanium layer on a substrate where a substrate is placed in a deposition chamber comprising a source of titanium, depositing the titanium layer onto the substrate in an atmosphere that comprises hydrogen (col. 14, lines 18-31). Stevens in view of Kitch et al. and Yamadai do not disclose the gas mixture during sputter deposition comprising at least 0.1 mole percent hydrogen.

Freeman et al. a method of forming a layer over a substrate where a substrate is placed in a sputter chamber containing a gas mixture of argon and hydrogen in the atmosphere and sputter depositing a layer over the substrate. Freeman et al. further disclose the gas mixture comprising at least 4 mole percent hydrogen (col. 4, lines 7-57).

Since Stevens and Freeman et al. are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Freeman et

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al. would have been recognized in the pertinent art of Stevens. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Stevens by the gas mixture during sputter deposition comprising at least 4 mole percent hydrogen as taught by Freeman et al. The higher the concentration of hydrogen in the atmosphere during sputter deposition there is an increase in the coercivity of the film formed on the substrate, meaning the polarity of the material changes only under the influence of a relatively large magnetic field (col. 7, lines 7-57).

Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevens in view of Kitch et al. and Yamadai as applied to claims 1-4, 9, 10, 18, 20 and 21 above, and further in view of Kaloyeros et al. (6,139,922).

Stevens discloses a method of forming a titanium layer on a substrate where a substrate is placed in a deposition chamber comprising a source of titanium, depositing the titanium layer onto the substrate in an atmosphere that comprises hydrogen (col. 14, lines 18-31). Stevens in view of Kitch et al. and Yamadai do not disclose providing power to the target with a power density of 3 to 8 watts per square centimeter.

Kaloyeros et al. disclose a method of forming a film over a substrate by a method of sputtering. Kaloyeros et al. further disclose the power used in the sputtering method having a power density of between 0.01 W/cm^2 and 10 W/cm^2 (col. 10, lines 60-67; col. 11, lines 1-17).

Since Stevens and Kaloyeros et al. are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Kaloyeros et al. would have been recognized in the pertinent art of Baum et al. Therefore, it would

have obvious to one of ordinary skill in the art at the time the invention was made to modify Baum et al. by applying powering to the target with a power density of 0.01 W/cm² to 10 W/cm² as taught by Kaloyeros et al. Under such conditions undesirable film contamination and electrical damage to the film are prevented (col. 11, lines 1-17).

Claims 19 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevens in view of Kitch et al. and Yamadai as applied to claims 1-4, 9, 10, 18, 20 and 21 above, and further in view of Hsu et al. (6,329,282).

Stevens discloses a method of forming a titanium layer on a substrate where a substrate is placed in a deposition chamber comprising a source of titanium, depositing the titanium layer onto the substrate in an atmosphere that comprises hydrogen (col. 14, lines 18-31). Stevens in view of Kitch et al. and Yamadai do not disclose the aluminum layer with a full width at half maximum (FWHM) x-ray diffraction signal of less than about 1.5 degrees.

Hsu et al. disclose a method of forming a titanium (9), titanium nitride (11), aluminum (19) interconnect. Hsu et al. further disclose the aluminum layer having a FWHM of 1.5 degrees (col. 3, lines 11-65).

Since Stevens and Hsu et al. are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Hsu et al. would have been recognized in the pertinent art of Stevens. Therefore, it would have obvious to one of ordinary skill in the art at the time the invention was made to modify Stevens by the aluminum layer having a FWHM of 1.5 degrees as taught by Hsu et al. because it improve the crystallographic orientation of the aluminum layer.

Hsu et al. do not disclose the aluminum layer having a FWHM of less than 1.5 degrees. It would have been obvious to one having ordinary skill in the art at the time invention was made to have a FWHM of less than 1.5 degrees for the aluminum layer, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955).

Allowable Subject Matter

Claims 11-17 are allowed.

The following is a statement of reasons for the indication of allowable subject matter: prior art does not anticipate, teach, or suggest a method of forming a titanium layer on a substrate where the substrate is placed in a sputtering chamber comprising a titanium target, flowing a first gas comprising hydrogen into the sputtering chamber through a first gas injector, terminating the flow of the first gas, after the flow of the first gas has been terminated, sputter depositing the titanium layer onto the substrate by applying power to the target and by providing a second gas in the sputtering chamber through a second gas injector, wherein the hydrogen is activated and whereby the deposited titanium layer has a preferred crystal orientation.

Response to Arguments

Applicant's arguments with respect to claims 1-22 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Pamela E Perkins whose telephone number is (571) 272-1840. The examiner can normally be reached on Monday thru Friday, 9:00am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

PEP


AMIR ZARABIAN
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